MONITORING OF *HOWELLIA AQUATILIS* (WATER HOWELLIA) AND ITS HABITAT AT THE HARVARD–PALOUSE RIVER FLOOD PLAIN SITE, IDAHO

by

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ABSTRACT

Howellia aquatilis (water howellia) is an aquatic macrophyte that is Federally listed as Threatened by the U.S. Fish and Wildlife Service. It occurs in internally drained ponds that dry out each year. In the Swan River Valley of Montana, where it is most abundant, *Howellia* occurs in ponds formed almost exclusively by glaciation. The single known Idaho location of the species occurs on the flood plain of the Palouse River in northern Idaho, in ponds formed by fluvial processes. The ponds are in the low points of abandoned channels or channel migration scars. In 1999, flood plain dynamics were characterized by mapping flood plain vegetation and relief, examining historical photos, and examining historic discharge data for the river. Vegetation, substrate, and configuration of ponds containing *H. aquatilis* were described and water-level gages were installed to monitor pond depth. In 2000, pond and river water levels were again monitored, soil samples were taken to characterize pond substrate, and photopoints were established to monitor vegetation changes at the ponds. The drying regime of the ponds was similar to that in 1999 and little difference in abundance of *Howellia* could be detected. The pond bottoms have a shallow O horizon where most of the plant roots are found. Beneath this are dense layers of fine-textured sediments, high in organic matter and highly acidic, with weak structure. This monitoring program will help us describe pond hydrology, and provide a basis for possible future management of the site. Threats to the population include invasion by the exotic graminoids *Phalaris arundinacea* (reed canarygrass) and *Acorus calamus* (sweet flag); and changes in land use.

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INTRODUCTION

Howellia aquatilis (water howellia) is an annual aquatic plant representing a monotypic genus in the family Campanulaceae. *Howellia* has very specific habitat requirements and has been rare throughout the period of botanical record. It is currently known from 13 sites in western Montana, northern Idaho, and eastern and western Washington (Shelly and Moseley 1988). It is rare throughout its range, occurring in ephemeral ponds and at the margins of permanent ponds, which in most cases are glacial potholes (Shapley and Lesica 1997). A detailed description of the plant, its biology and habitat can be found in Shelly and Moseley (1988). *Howellia* is listed as Threatened by the U.S. Fish and Wildlife Service.

The life cycle of *Howellia* is intimately tied to the hydrology of the ephemeral ponds that comprise its habitat. As an annual plant, viability in the short term depends on hydrologic conditions necessary for seed production and germination. Long-term survival of metapopulations may depend on the density and diversity of ponds available (Lesica 1992). Habitat management for *Howellia* requires an understanding of pond hydrology and geometry (Shapley and Lesica 1997) and the impact on ponds and wetlands from colonization by exotics (Lesica 1997).

In Idaho, the sole *Howellia* site is on the flood plain of the Palouse River, in ponds formed within scars created by migration of the river channel (Lichthardt and Moseley 2000; Appendix 1). Three ponds, each less than 0.1 hectare in area occur on a parcel of private land that has been used for cattle grazing.

In 1999, the fluvial processes of the flood plain were examined by looking at historical photos and mapping vegetation at the site (Lichthardt and Moseley 2000). Specific 1999 tasks included 1) characterization of the flood plain vegetation, 2) description of general and localized habitat of *Howellia*, 3) examination of historical photos and flow data, and 4) installation and monitoring of water depth gages.

A habitat and population monitoring program is one of the recovery actions specified in the draft Recovery Plan (Shelly and Gamon 1996). Monitoring was continued in 2000, with the following four tasks being accomplished:

1. Pond water-depth gages were monitored at least monthly from March to October.

2. *Howellia* populations were mapped.

3. Photopoints for monitoring vegetation were established at all three ponds.

4. Bottom sediments of the ponds were characterized.

This work can provide the basis for a future management plan for the site focusing on the long-term maintenance of *Howellia* habitat.

MONITORING

Populations

Howellia subpopulations at the Harvard ponds were checked by Karen Gray, Idaho Conservation Data Center (CDC), on July 15, 2000. *Howellia* had begun flowering by June 23. Unfortunately, by July 15 pond 1 held no standing water, and no *Howellia* plants were found. In pond 2, *Howellia* was abundant, especially in the narrow, shaded arm (spur) of the pond where it had been abundant the year before (Appendix 2). The 1999 estimate of 50 m^2 (Table 1) was very conservative, allowing for patchiness in distribution. Notes taken in 1999 indicated that *Howellia* occurred "throughout the spur," which is at least 200 m^2 in size. In 2000 it occupied the central portion of the spur, or approximately 100-120 m^2, plus two other small spots within pond 2 in 0-15 cm of water. At this time, the deepest portion of the pond was 22 cm (Table 2). In pond 3, *Howellia* again occupied only a small area but was slightly displaced from where it was growing in 1999. This information was used to update the element occurrence record (EOR) for *Howellia* in the CDC database (Appendix 3).

Table 1. Approximate area occupied by *Howellia aquatilis*, 1999 and 2000.

	1999	2000
	sq. meters	
Pond 1	0.5	No data
Pond 2	50.0	110.0-130.0
Pond 3	0.5	0.5

Water levels

Table 2 shows the cumulative water level data for 1999 and 2000. Ponds lose water very slowly from March to July (Figure 1), then drop rapidly during the first half of July, probably due to increased evaporation. In both years, ponds 1 and 3 were dry or nearly so by mid-July and pond 2, the largest, was dry by August 3. Only one complete cycle from full-pond to empty has thus far been documented. Pond levels did not reflect changes in river stage that occurred in mid-June 2000, but pond 2 did change with the increased river stage in mid September. The September, 2000 reading shows that pond 2 accumulated a decimeter of water from early September rains while the other two remained empty.

Photopoints

It was very difficult to establish photopoints (Appendix 4) because of the dense vegetation around the ponds. Pond 2 photopoints are a short distance up the steep slope adjacent to the pond. Because of the lack of any good vantage point for pond 3, a 3-ft

high platform was built and installed on the east side of the pond where there is a short slope up to the road. Small branches will have to be cut out each year that photos are taken. Photos were taken on May 25, when ponds appeared to be near normal high water (as indicated by wetland vegetation) and again on September 12. Possibly an additional photopoint, taken from within the pond itself, should be tried at each pond. This would have to be located to minimize disturbance to *Howellia*, but would not be as obstructed as the others by vegetation.

Table 2. Depth of water in *Howellia* ponds with concurrent river discharge rate and stage[1], 1999-2000.

Date	Water depth (m)			Discharge	Stage
	Pond			(cfs)	(m)
1999:	1	2	3		
July 1[2]	.2	no data	no data	50	1.68
July 13[3]	0	.24	0	28	1.62
July 16	0	.21	0	25	1.58
Aug. 3	0	0	0	14	1.55
2000:					
March 27	.53	.54	.67	918	2.68
April 24	.50	.48	.55	500	2.32
May 23	.42	.46	.44	122	1.83
June 13	.37	.44	.42	338	2.13
June 23	.27	.42	.34	76	1.74
July 15	0	.22	.02	24	1.58
Aug. 3	0	0	0	12	1.52
Sept. 12	0	.10	0	44	1.65
Oct. 6	0	0	0	17	1.55

[1] Discharge rate and stage measured at the USGS gage, 24 km downstream.
[2] All three ponds contained water on July 1, prior to installation of gages. Pond 1 depth is an estimate.
[3] Gages installed.

SUBSTRATE CHARACTERIZATION

The substrate of ponds with *Howellia aquatilis* is of interest because of its influence on both seed germination and pond hydrology. Any attempt to create or restore habitat will require a knowledge of substrate characteristics. To characterize pond substrates, two subsamples were taken from each pond. Ponds 1 and 2 were sampled near the deepest point in the pond, within the plant community where *Howellia* occurs. Pond 3 samples were taken from near the edge, where *Howellia* has been observed for the past two years. In the top 30 cm of soil, three horizons were distinguishable, differing in the presence of roots, color, and texture. A sample was taken from each different horizon.

Figure 1. Changes in pond depths and river stage, March 27 to October 6, 2000.

Roots were concentrated in the upper 5 cm of soil which was loose and friable. Beneath this horizon the soil was dense, with very weak structure. The moist color was gray, with abundant red mottles related to alternating oxidizing/reducing conditions. In pond 2 there were undecomposed *Acorus* stems in subsurface horizons and in pond 1 bits of charcoal. Pond 3 had a more well-developed O horizon than the other 2 ponds, was very friable to 28 cm, and below 28 cm was very dense with abundant mottles.

Samples were analyzed at the Pedology Lab at the University of Idaho (Table 3). Particle-size distribution was determined by sedimentation, and sieving for sand fractions (Table 4). Organic matter was determined by dichromate oxidation. Surface horizons had high amounts of organic matter, that of pond 3 approaching the definition of an organic soil (>20%). The higher organic matter content in pond 3 may reflect its different bottom vegetation. Underlying horizons were high in silt (ponds 1 and 2) or silt and clay (pond 3). The dominance of small particle sizes would make permeability very low. All horizons were strongly acidic, with most ranging between 4 and 5. These soils differ from those of some Montana ponds which have deep organic horizons (Mantas 1998).

Table 3. Characteristics of bottom sediments in ponds containing *Howellia aquatilis*.								
Pond	Sample	Depth	Sand	Silt	Clay	Texture	OM	pH
		cm	%				%	1:1
1	1	0-7	7.2	74.2	18.6	Silt loam	7.6	4.2
		7-12	7.9	75.0	17.1	Silt loam	2.6	4.5
		>22	21.0	47.9	31.1	Clay loam	2.6	4.7
	2	0-5	4.3	71.9	23.8	Silt loam	9.5	4.4
		5-12	11.2	68.7	20.2	Silt loam	4.4	4.4
		>22	16.4	57.9	25.6	Silt loam	2.1	5.4
2	1	0-5	9.3	65.3	25.4	Silt loam	11.6	4.5
		5-12	7.7	74.7	17.6	Silt loam	4.8	4.4
		12-25	8.8	70.7	20.5	Silt loam	4.7	4.5
	2	0-5	8.1	68.3	23.6	Silt loam	8.5	4.2
		5-12	9.5	73.1	17.4	Silt loam	4.6	4.5
		12-25	10.1	68.2	21.3	Silt loam	5.8	4.5
3	1	0-5	13.4	54.0	32.6	Silty clay loam	16.8	4.7
		5-16	8.5	45.3	46.2	Silty clay	9.5	5.0
		16-28	7.5	44.6	48.0	Silty clay	9.2	5.3
	2	0-10	12.2	47.8	40.0	Silty clay	11.2	4.8
		15-22	11.0	45.0	44.0	Silty clay	9.5	5.2
		>28	10.1	36.0	53.9	Clay	4.6	5.2

CONSERVATION ASSESSMENT

Howellia has been known at this site since ca. 1968 and has probably occupied all three ponds since this time, although no information on abundance or specific location is available prior to 1988. The population is prone to extinction due to its small size. It is susceptible to stochastic events, pond sedimentation, weed invasion, absence of available habitat, and changes in land use. One or more subpopulations could be eliminated by any event that effects pond hydrology. The most imminent threat is probably changes in pond morphology as a result of the natural sedimentation of the ponds and of the incursion of both *Phalaris arundinacea* and *Acorus calamus*. The long-term viability of this population has probably depended on formation and subsequent colonization of new ponds. The Palouse River through the site is an uncontrolled river with natural flood regimes, but fluvial processes have been altered by the highway berm crossing the floodplain at the upstream property boundary.

As long as the property is in private ownership there is danger of development or conversion to agricultural use. There are cattle on the property from time to time during the summer but they do not appear to impact the ponds.

Table 4. Sand fractions in the substrate underlying *Howellia* ponds.								
	Sample	Depth	Very coarse sand	Coarse sand	Medium sand	Fine sand	Very fine sand	Total sand
		cm	%					
Pond 1	1	0-7	0.2	0.3	0.5	1.5	4.7	7.2
		7-12	0.1	0.2	0.2	0.6	6.8	7.9
		>.22	0.2	0.3	0.5	5.0	15.0	21.0
	2	0-5	0.4	0.6	0.6	1.5	1.1	4.3
		5-12	0.7	0.2	0.3	1.9	8.2	11.2
		>22	0.3	0.3	0.2	4.1	11.5	16.4
Pond 2	1	0-5	2.4	1.1	0.6	1.3	4.0	9.3
		5-12	0.4	0.2	0.3	1.7	5.0	7.7
		12-25	0.3	0.1	0.1	0.8	7.4	8.8
	2	0-5	0.9	0.6	0.6	1.7	4.3	8.1
		5-12	0.3	0.2	0.2	1.4	7.4	9.5
		12-25	0.2	0.4	0.5	2.0	7.0	10.1
Pond 3	1	0-5	1.0	1.0	0.8	2.7	8.0	13.4
		5-16	0.4	0.8	0.9	2.6	3.7	8.5
		16-28	1.0	0.9	0.8	2.3	2.6	7.5
	2	0-10	0.7	0.9	0.9	3.1	6.6	12.2
		15-22	0.5	0.7	0.9	3.4	5.4	11.0
		>28	0.2	0.1	0.2	2.1	7.6	10.1

RECOMMENDATIONS

Monitoring

I recommend that monitoring of water levels and populations be continued at least through 2002. Only one complete cycle from pond-full to dry has been documented thus far. Data from a range of years including wet summers or dry winter-springs would help identify relationships between pond hydrology and *Howellia* abundance. The markings on the gages fade after 2 summers, so they should be remarked every year if possible, although a meter stick inserted at the gage location could also be used. Population monitoring provides information on fluctuation in population size and location within the ponds.

Photomonitoring is important in detecting longer-term changes in vegetation and associated morphology of the ponds. Photopoints should be repeated in 2002 and then again no later than 2005. Photos should be taken in late June/early July to coincide with population monitoring. I suggest one more photopoint be established at each pond, which will be taken from a point within the pond itself.

Management

Because encroachment of the ponds by *Phalaris arundinacea* and *Acorus calamus* appears to be the most imminent threat, research should be done into possible options for control of these plants.

The owner of the property that comprises the site should be contacted again, by mail, to update her on ongoing work and the status of the population.

ACKNOWLEDGEMENTS

Continued access to this site is only possible through the graciousness of property owner Ruth Ownbey whose late husband first discovered the population of *Howellia aquatilis*. It is thanks to her that the property remains a sanctuary for wildlife and native plants.

I would also like to thank Karen Gray and Bertie Weddell for conducting the year-2000 *Howellia* survey.

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SOME APPENDICES MAY NOT BE AVAILABLE ON THE WEB

Appendix 1

Location of *Howellia* ponds at the Harvard–Palouse River Flood Plain site

Appendix 2

Pond diagrams showing the locations of *Howellia* in 2000

Appendix 3

Element occurrence record for *Howellia aquatilis* 001

Appendix 4

Photopoints for *Howellia aquatilis* ponds at the Harvard-Palouse River Flood Plain site, and year-2000 photos

Photopoints for *Howellia aquatilis* ponds at the Harvard-Palouse River Flood Plain site.

(19˚ east declination used for bearings)

POND 1

Photopoint 1: from base of large spruce at east edge of pond, 125˚ from gage, standing next to tree on its south side.

Photopoint 2: from blaze on trunk of large downed Douglas-fir, 330˚ from gage and 315˚ from large spruce on opposite side of pond.

Photopoint 3: from slope end (south end) of downed Douglas-fir (flat spot), 280˚ from gage.

Photopoint 4: (may be added in 2001)

POND 2

Photopoints 1 and 2 are upslope of pond 2.

Photopoint 1 (upper): from under the drip-line of a grand fir located at the forest edge, which is the largest tree in the vicinity. Tree is next to a large cut-stump. Stand 4-5 m at 40˚ from trunk, approximately south of gage.

Photopoint 2 (lower): just under the dripline of a pole grand fir and east of a pole Douglas-fir, upslope from a tall alder at the pond edge, 235˚ from the gage. Saplings are the only trees downslope. Point is approx. 4 m downslope of the trunk of a pole grand fir growing next to a maple. Photo taken at azimuth 40˚, with tallest alder at left of frame.

Photopoint 3: (may be added in 2001)

POND 3

Photopoint 1: standing on 3-ft platform, in opening among hawthorn on highway side of pond; gage at left (30 mm focal length).

Photopoint 2: from below and slightly north of platform, at pond edge (where shrubs rooted); 80˚ from gage (50 mm).

Photopoint 3: from pond edge, 10˚ from gage.

Photopoint 4: (may be added in 2001)

Captions for year-2000 photos:

(Focal length = 50 mm except where noted otherwise)

1.	5/25/00	Pond 1, photopoint 1	Gage on right.
2.	5/25/00	Pond 1, photopoint 1	Gage at center; downed Douglas-fir in background.
3.	5/25/00	Pond 1, photopoint 1	Gage at center; f.l. 30 mm.
4.	5/25/00	Pond 1, photopoint 2	North half of pond with gage on right.
5.	5/25/00	Pond 1, photopoint 2	South half of pond with gage on left.
6.	5/25/00	Pond 1, photopoint 3	Spruce (photopoint 1) is just right of center in background.
7.	5/25/00	Pond 1, photopoint 3	Trunk of spruce is just out of frame, upper right.
8.	5/25/00	Pond 2, photopoint 1	Gage in lower center.
9.	5/25/00	Pond 2, photopoint 2 (lower)	West "arm" of pond in foreground, gage visible through shrub on right. Yellow-green emergent is *Acorus calamus* and bluish grass behind it *Phalaris arundinacea*.
10.	5/26/00	Pond 3, photopoint 1	Gage visible just above and left of center (30 mm f.l.).
11.	5/26/00	Pond 3, photopoint 2	Gage at left.
12.	5/26/00	Pond 3, photopoint 2	Looking toward photopoint 3 and flags marking 1999 *Howellia* population; pond edge at right; *Eleocharis palustris* is the emergent.
13.	5/26/00	Pond 3, photopoint 3	Flags in lower left mark the 1999 population of *Howellia aquatilis*.
14.	9/12/00	Pond 1, photopoint 1	
15.	9/12/00	Pond 1, photopoint 2	
16.	9/12/00	Pond 1, photopoint 3	Gage center.
17.	9/12/00	Pond 2, photopoint 1	Gage just below center.
18.	9/12/00	pond 2, photopoint 2	
19.	9/12/00	Pond 2	Location of pond 2 relative to forest slope; flattened *Acorus* stems; gage at right.
20.	9/12/00	Pond 3	Bottom with dried *Eleocharis* and flags marking 1999 population.